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HEARING ON ETHYL CORPORATION FUEL WAIVER APPLICATION
U.S. ENVIRONMENTAL PROTECTION AGENCY
401 M Street, S.W.
EDUCATION CENTER AUDITORIUM
WASHINGTON, D.C. 20036

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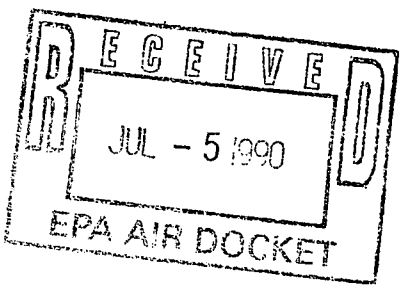

PANEL MEMBERS:

Mr. Richard Wilson, Chairman
Director, Office of Mobile Sources

Ms. Mary Smith
Director, Field Operations and
Support Division

Mr. Dwight Atkinson
Office of Policy, Planning and
Evaluation

Ms. Margaret Gilhooley
Office of General Counsel

Mr. Ken Poirier
Environmental Criteria and
Assessment

ALSO PRESENT:

Mr. David Kortum
Environmental Protection Agency

F. William Brownell, Esq.
Counsel for Ethyl
Hunton & Williams

WITNESSES:

Ellen Silbergeld
Environmental Defense Fund

James Derderian, Representing
Honorable Thomas J. Bliley, Jr.

Mr. Duncan, Representative for
Honorable Richard H. Baker

Dewey Mark

Everett L. "Red" Hodges

John Donaldson
Bio-Tox Resources

Ray Wilkins, Jr.
Senior Vice President
Ethyl Corporation

Gary Ter Haar
Vice President, Health and Environment
Ethyl Corporation

P R O C E E D I N G S 9:00 a.m.

CHAIRMAN WILSON: Good morning everybody. I'm Richard Wilson. I'm Director of the Office of Mobile Sources at the Environmental Protection Agency here. I'll chair today's hearing on the Ethyl Corporation's Fuel Waiver Application.

Welcome to the hearing. For the record, this hearing is convened on June 22, 1990 at 9:00 in the EPA Auditorium at EPA Headquarters, 401 M Street, SW, Washington, D.C.

The purpose of this hearing is to provide EPA with oral testimony regarding the recent application by Ethyl to utilize Hi Tec 3000, also known as MMT -- I'll avoid going through the chemical term, we'll get into that later -- as an additive to unleaded gasoline.

Statements by the participants will not be subject to cross examination by others who testify however the panel may ask participants questions concerning their statements.

The hearing will be conducted informally and technical rules of evidence will not apply. A written transcript of the hearing will be taken and anyone desiring to purchase a copy of the transcript should make individual arrangements with the Court Reporter reporting the proceedings.

The transcript will also be placed in the Public Docket, No. A-90-16 of the Air Docket of EPA and copies of the transcript as well as other pertinent documents may be

Ethyl's first application was submitted on March 17, 1978 for concentrations of MMT resulting in 1/16th and 1/32nd gram per gallon manganese in unleaded gasoline.

Ethyl's second application was submitted on May 22, 1981 for concentrations of MMT resulting in 1/64th gram per gallon manganese in unleaded gasoline.

The Administrator denied these requests for waivers primarily due to increased hydrocarbon exhaust emissions associated with the use of MMT.

If the prohibitions against MMT were waived by the Administrator, it is highly likely that most U.S. gasoline would contain some level of MMT and therefore it is also highly likely that fuels used in certifying vehicles under Section 206 of the Act would be required to reflect this compositional change.

At this point I'd like to introduce other members of the panel here today. On my left, Mary Smith, Director of the Field Operations and Support Division. On her left, Margaret Gilhooley of the Office of General Counsel. Next to her, Dwight Atkinson of our Office of Policy, Planning and Evaluation. Next to him, David Kortum of the Field Operations Court Division and on my right, Ken Poirier or Environmental Criteria and Assessment, Office of EPA.

The Administrator's decision on this application for waiver will be made on the basis of the public record so we

encourage comments on Ethyl's waiver application and on today's presentation and now we'll begin the testimony from the various witnesses. Is Congressman Baker here?

(No Response.)

Is James Derderian here from Congressman Bliley's office? No? If not, we'll start with Ellen Silbergeld, Environmental Defense Fund.

MS. SILBERGELD: Thank you very much for the opportunity to comment on the application for a waiver by Ethyl Corporation for using MMT, ~~Methylpentadine~~ methylcyclopentadienyl manganese tricarbonyl ~~Neomanganese Tripardinalas~~ a gasoline additive.

EDF submits these comments on this application at this time and we do intend to submit an expanded version of these comments before the close of the public comment period. The document that I've given to you is for purposes of the public hearing.

Over the past decade I've served on several EPA committees charged with assessing environmental fate, transport and health impacts of another organo metal gasoline additive also manufactured by Ethyl, that is tetraethyl lead.

Since receiving my doctorate from Johns Hopkins I've also actively conducted basic and clinical research on the effects of low level chronic exposure to both lead and manganese. While I was at NIH I provided expert opinion via

the Director of the Neurologic Institute to the government of Bolivia on the potential effects of manganese in drinking water.

More recently I served on the peer review panel for EPA's most recent health assessment document on manganese and I also reviewed the recent Health Effects Institute paper on the health effects of manganese as an additive to gasoline.

EDF strongly opposes granting this waiver application. The Clean Air Act provides that EPA, quote, "May", quote, "Grant a waiver allowing the use of manganese as a fuel additive upon determining that the additive will not impair emissions control devices such as the catalytic converter."

Regardless of the effects of MMT on emissions control, there is no dispute that manganese is neuro toxic to humans. It is on this basis that EPA should deny this waiver. Particularly since Ethyl has yet again failed to provide relevant or convincing evidence on two critical points.

One, that the use of MMT will not effect human health and two, that the use of MMT will not measurably add to the environmental loadings of manganese in critical compartments directly related to human exposure.

EDF believes that it would be a serious abrogation of EPA's clear responsibility under the Clean Air Act to protect human health of it were to do otherwise. In fact,

it's a rare opportunity to apply clear lessons of past experience to a very similar application.

To disregard these lessons, the lessons of the past 55 years, by approving the wide spread and inherently dispersive use of another neuro toxic metal is to invite repetition of a public health catastrophe which we know now has been associated with the use of lead as a gasoline additive from 1925 to the present.

I need not document to you the epidemic status of childhood lead poisoning in the United States. This is clearly laid out in the 1988 ATSDR report to Congress and it is also quite clear of the important and significant role played by tetraethyl lead additives to gasoline in contributing to that epidemic.

This is an experience we cannot afford to repeat. The parallels between Ethyl's proposal in 1990 to use manganese and it's proposals from 1922 to '25 to use lead are rather chilling. In other cases the exclusive basis for this application was and is its purported effect on automotive efficiency and emissions of hydrocarbons and other pollutants from cars.

No data were submitted in 1922 and none are submitted now that are relevant or convincing on the potential cumulative health effects of massive inputs of a toxic metal into the environment, its deposition into surface dusts and

soils and its long-term fate and exposure pathways to humans.

In 1925 Ethyl argued that the amounts of lead to be added to gasoline were of negligible importance and that lead was only toxic at the high doses encountered in certain industrial settings.

In 1990 Ethyl argues that the releases of manganese to the environment will be insufficient and that manganese is only toxic at high doses in industrial settings. As Yogi Berra once said, deja vu all over again.

In both cases, Ethyl has suggested that acceptance of its additive is of critical importance to the nation. In 1990, amazingly, Ethyl finds it unnecessary to do anything more than it did in 1925. Wholly inadequate data have been presented to you to indicate that adding manganese to gasoline will not change concentrations of manganese in ambient air over the short-term in some selected Canadian cities.

Ethyl does not cite a recent study from California and we have appended to our testimony an annotated bibliography including that report. A recent study from California which demonstrates that increases in airborne and deposited manganese are related to additions of manganese to gasoline already permitted by EPA.

No in-depth discussion of the health effects of

manganese is presented nor, more importantly, is there a discussion of the critical data gaps on manganese toxicity that must be filled before any decision can be approved that would result in tons of manganese released into the environment.

EPA must assert its leadership role in 1990 to defend the preventative impairment of its mandate to protect human health and the environment.

What's at stake here is not the health of emissions control devices and automobiles but the health of humans. This waiver cannot be approved until the applicant provides substantive information on the cumulative impacts of manganese additives on environmental quality and not solely ambient air concentrations and convincing evidence that such impacts will not adversely effect the health of any segment of the human population over the long term.

In making this case, Ethyl must demonstrate that the likely experience with manganese will not resemble that with lead. We expect that this will be difficult to show. Both lead and manganese are elements and as such, they will not degrade or quickly disappear from stable environmental compartments such as soils, dusts and sediments.

Patterns of use will result in relative enrichment in urban, densely populated areas with high levels of vehicular traffic and residential patterns such that persons are in

close contact with the areas most heavily impacted by fallout from vehicle emissions.

All of this we know from lead. Although the proposed per gallon use of manganese is less than the usage of lead in gasoline at its peak prior to regulation in 1978, the vastly increased amount of gasoline consumed and number of vehicle miles driven in the U.S. in 1990 as compared to the 1920's will insure that the rate of contamination of our environment from this source will be comparable.

Both lead and manganese are neuro toxic metals. While the data on manganese is relatively sparse compared to lead -- but of course we haven't yet conducted massive human experiments with manganese -- that's what you're being asked to approve. The hazard identification of manganese as a neuro toxin and lung toxin is clear.

Manganese, like lead, is a cumulative toxin in that both its absorption and retention as well as its toxicity increase with time. At present there are insufficient data on the low level chronic sequelae of manganese exposure, similar to the case that was made for lead in 1925.

There are no data on the effects of manganese on the aging brain although there is good reason to believe that the nature of manganese-induced patho-physiology, that is, damage to the nigrostriatal neuronal system of the brain, is such that a positive, worrying interaction with normal cell

loss during senescence would be expected.

The potential for selective susceptibility to manganese in the aged must be of great concern as the U.S. population itself ages. Moreover, the possibility that iron deficiency may potentiate manganese toxicity and again, reference is cited in the attached bibliography, is of considerable concern, given the prevalence of iron deficiency in the United States.

The mechanisms by which manganese damages neural tissue, particularly neurons using catecholamines as transmitters, are unknown so that we cannot propose an overall dose response relationship or a rational basis for risk assessment.

There are inadequate studies on the immuno-toxic effects of MMT or manganese. The toxico kinetics of low dose manganese exposure are not known and there are puzzling differences between rodent and primate models.

Moreover, the expression of sever ape kinetic and neuro psychiatric symptoms in workers exposed to manganese are not clearly associated with increased concentrations of manganese in brain at autopsy, further indicating that the mechanisms as well as the toxico kinetics of manganese are not yet well understood.

We have no defined biological markers for manganese exposure in humans so that our interpretation of the

available epidemiologic studies is presently limited.

In summary, both what we know and do not know at present about the likely toxic effects of adding manganese in large total amounts to the environment must persuade EPA to reject this application.

We know that manganese at high dose is a demonstrated human neuro toxin with persistent and irreversible pathological effects on the brain structure and resulting severe impairments in movement and mental state.

We do not know what the long-term chronic low dose consequences of human exposure to manganese are. We do not know a, quote, "safe level" of manganese exposure, particularly for those subgroups that may be at increased risk for neuro toxicity, in this case, the aged.

We do not know if manganese is carcinogenic although there is evidence that it can break DNA. With respect to exposure assessment, on the other hand -- and this is very unusual in a situation where EPA must come to a judgement on inadequate data, incomplete data sets -- with respect to exposure assessment, we know a great deal based on our tragic experience with lead about the likely cumulative impacts of such a use upon human exposure to manganese.

We know that the gradual contamination of the environment by this additive will not be readily reversed, that manganese will accumulate in specific parts of the

environment, many of which are subject to intensive human interaction such as urban dusts and soils.

We know that manganese in air and in surface dusts and soils will present directly to humans as a source of exposure.

Ethyl has chosen to focus its application on the purported efficacy of manganese additives to reduce certain pollutant emissions from vehicles. In a well-known publicity campaign over the past week, Ethyl has sought to harness concerns over the impacts of these air pollutants on global and local air quality as justification for this application.

Ethyl has selectively cited bits of data in support of its contention that use of MMT will not increase manganese concentrations in air in cities. Ethyl has provided no data on the impacts of manganese additives on manganese concentrations in more stable post-deposition compartments such as dusts and soils.

Ethyl has provided no in-depth review of the data and data gaps on manganese toxicity and I might add that most expert reviewers of the Health Effects Institute Review came to the same conclusion about the inadequacy of paper as well.

In 1925 Ethyl introduced its new product, tetraethyl lead as, quote, "A gift of God." It has taken us over 50

years to realize how diabolical this gift has proven to be.

Reduction of lead in gasoline represents one of the most significant public health achievements of the EPA. You, Mr. Wilson, and others can take justifiable pride in participating in that.

Now, in 1990, Ethyl comes bearing yet another gift. To this offering, EPA should just say no. The purported benefits of reducing climatic impacts cannot be achieved upon the rack of an epidemic of manganism.

EDF urges rejection of this application and also immediate suspension of all permitted use of manganese as a gasoline additive in the United States.

CHAIRMAN WILSON: Thank you for your testimony. We have a few questions. Can you compare what the exposures -- environmental exposures to people would be from the use of this additive in relation to other sources of manganese?

MS. SILBERGELD: Yes. I would estimate that the exposures to manganese from this use would result in a general and wide spread increase in the exposures of the American public to manganese overall, therefore, on a population basis the average or median exposure of Americans to manganese would increase.

Compared to specific point sources or industrial exposures, of course, these exposures would be lower. However, they would be chronic and life-long and they would

be encountered by persons in all age groups and at all stages of nutritional sufficiency or deficiency.

Again, one can draw very close parallels with our experience with lead in that of course there are occupational settings were exposures to workers and others are much more intensive to lead then they are in the general environment. Nevertheless, 55 years of the use of lead as an additive has substantially increased the median and individual body burdens of lead in the American public.

We know this in both the prospective and retrospective sense, as I'm sure you're aware. That is, by studying various tissue repositories we know that in the period from 1925 to 1975 body burdens of lead have increased enormously and these can only be ascribed to a general wide spread and dispersive source.

We also know that in the period of time when we started to take lead out gasoline we also succeeded in taking lead out of children's bodies.

CHAIRMAN WILSON: Ethyl argues in its application a couple points on the pro environment and I guess pro health side. One is that this additive would lower the emissions of at least carbon monoxide and nitrogen oxide.

They also argue that it would provide octane in a way that would allow refiners to, if they chose, use less other constituents in the gasoline that perhaps themselves are

toxic, for example, aromatics.

Do you have a comment on the potential trade off here between the beneficial uses of the additive versus the problems?

MS. SILBERGELD: Well, with respect to the purported beneficial uses, which I think are still a matter for some examination by the EPA, as a toxicologist I would comment that as a general rule the dispersion of a stable element that is toxic in the environment has potentially much more far-reaching and adverse economic and health costs than the disbursal of a relatively short-lived aromatic or other kind of contaminant.

MR. POIRIER: In your statement you primarily seem to be concerned with oral exposure of manganese. Do you have a comment on inhalation as well at this point?

MS. SILBERGELD: No. I'm not primarily concerned about oral exposure. I'm concerned about releases that will first enter the ambient local air environment but I expect that the post emission behavior of manganese in an oxide or whatever other form it leaves the automobile will closely resemble that from lead and that the post deposition exposure routes will include some inhalation but also include ingestion as this material becomes mixed in dusts and soils, contaminates surface water and the food supply.

MR. POIRIER: Thank you.

MS. SMITH: Ethyl states in its application that it tried to measure the amount of manganese coming out of the tailpipe and that it's something like one half of one per cent of what's going in. If these assertions are true, are your concerns still as great as your testimony indicates?

MS. SILBERGELD: Well, first off I was told that by Dr. Ter Haar also and I find that inherently a somewhat puzzling statement just from the point of view of mass balance of physics.

It may be that Ethyl is claiming that only a small per cent of this additive will leave the tailpipe as MMT and in that case it would resemble what is known about ... tetraethyl lead, that in fact in the combustion process most of it does end up being emitted in inorganic form as an oxide or a halide so that if that is the contention of Ethyl, that's probably true.

Let me state quite clearly, my concern is not with MMT, that is with manganese as an organo metal although there are substantial concerns about that compound.

My concern is about the accumulation of manganese as manganese. Moreover, if in fact much of the manganese remains in the car which is a statement that has yet to be proven not to be ... at some point that manganese accumulation will enter the environment through the waste

stream or some other source and as EPA knows, for instance, the disposal of used oil has proven to be a very difficult issue because of contamination by lead.

MR. ATKINSON: Can you give me some information about the relative health effects of ~~injection~~ ingestion versus inhalation? For example, I took a vitamin this morning. I looked on the back of the bottle. It had two and a half milligrams of manganese in it -- as manganese sulfate -- and in preparing for the hearing I found out that bananas and a number of spices and so forth have a lot of manganese in it. Why are we not so concerned with that type of ~~injection~~ ingestion? Or should we be?

MS. SILBERGELD: Manganese is an essential trace element and is very critical, particularly during development so that, unlike lead, a case cannot be made that any exposure to this metal represents some increment of risk.

However, loadings of the environment, increasing the chronic exposures, particularly in persons long past development, may have significant toxic effects even at doses that for the developing organism are entirely part of ordinary metabolism and trace mineral metabolism.

With respect to your question about the oral versus inhaled dose, it is somewhat difficult to extract these issues from the available epidemiologic evidence but in so

far as one can, in circumstances where there is an opportunity for inhalation dose such as in primary smelters and ferro manganese alloying industries, there appear to be effects of manganese on the lung which may result from direct interaction of manganese entering the ~~uvular~~ alveolar pathway.

MR. ATKINSON: That's separate from your neuro toxicological effects?

MS. SILBERGELD: That is separate from the neuro toxic effects. Neuro toxic effects are also expressed in persons in similar industries but it appears that in inhalation circumstances the lung becomes a critical target organ.

When ~~infection~~ ingestion appears to be the sole route of exposure -- and these are primarily these studies of manganese in drinking water -- then lung involvement is not characteristically seen but there may be some suppression of the immune system and neuro toxic effects.

Chairman Wilson ~~MRS. WHITE~~: I think that's all the questions. Thank you very much for your testimony. I understand Mr. Derderian has arrived. How are you?

MR. DERDERIAN: Good morning, Mr. Chairman, Panelists. I'm James Derderian, Legislative Director for The Honorable Thomas J. Bliley. A scheduling conflict did not permit the Congressman to be here in person so I'd like to read his statement for the record.

"I appreciate this opportunity to provide my views on the waiver application by Ethyl Corporation for permission to use their fuel additive, Hi Tec 3000 in unleaded gasoline.

"I'm interested in this proceeding for two reasons. First, I am the Congressman that represents the Headquarters of Ethyl Corporation and the health and welfare of my constituents are important.

"More importantly, as a long-term member of the Subcommittee on Health and Environment and the Committee on Energy and Commerce, I've been involved in the public policy debate over clean air legislation for 10 years.

"The issue involved in this waiver applications are the same ones as we've been debating in our committee for years and of course the same ones on which we've been negotiating in the current revision of the Clean Air Act.

"Hopefully we will conclude this very important bill in the next few weeks and have it ready for the President's signature shortly thereafter.

"In this legislation we're trying to take another step forward to clean up our air. Among other things, we're tightening tailpipe standards, we're attempting to foster cleaner fuels and we're establishing new restrictions on stationary sources of pollution.

"Major opposition to these and other provisions in the

bill comes largely from interests that must bear the high, high cost of making these changes.

"I think it is important to note that the subject of this hearing is a product that will help accomplish all three of these objectives that I just mentioned. It will reduce tailpipe emissions by 7.8 per cent, the most notable component of this reduction is NOx, which is cut by 20 per cent.

"Secondly, it will help the refiners clean up gasoline. Its octane producing property will allow the refiner to meet octane requirements without including some of the more noxious and controversial components such as benzine and other aromatics.

"In addition, for the same reason, it allows the refiner to reduce the vapor pressure of gasoline, which has been a long sought goal of the subcommittee.

"Finally, because it allows the refiners to reduce the process severity, it will allow them to reduce their stationary source emissions.

"What I find so attractive about this product is that it can do all of these things in an economical way. We in Congress do not have to legislate its use. We do not have to fund it or subsidize it. If buyers at the wholesale or retail level do not want to use it, they don't have to. But it helps them lower tailpipe emissions and it saves them

money.

"If we had more options like this one, improving air quality would be a much easier job. As you know, Mr. Chairman, my purpose is not to endorse a product but to highlight its importance in terms of public policy, reducing tailpipe emissions, especially NOx and producing cleaner gasolines and end point source emissions.

"I've certainly been impressed by the potential environmental benefits of this product and I urge you and the panel's strongest consideration of this waiver application. Sincerely, The Honorable Thomas J. Bliley."

CHAIRMAN WILSON: Thank you. I understand Mr. Duncan, representing Congressman Baker is here?

MR. DUNCAN: Good morning.

CHAIRMAN WILSON: Good morning.

MR. DUNCAN: Thank you for the opportunity to represent Congressman Baker this morning. He also had obligations back in the District and was unable to be here this morning. And I'll also read you the statement that he wrote last night.

"Good morning. I'm Congressman Richard Baker from the 6th District of Louisiana. My District includes Baton Rouge which is the location of the headquarters of Ethyl Corporation's chemical group. It is also the location of a number of other chemical and petroleum operations.

"I'm very happy to testify on behalf of one of my constituents. What really motivates my support of this fuel waiver application for Hi Tec 3000, though, is the benefit this product offers our community.

"Like many cities around our country, Baton Rouge suffers from ozone episodes. Already we in Baton Rouge have formed a taskforce made up of industry, state and local government to develop a plan to reduce the frequency and severity of these episodes.

"In view of this, I'm quite interested to learn the Ethyl Corporation was attempting to obtain approval from the EPA to market a product that would reduce automobile emissions of nitrogen oxide by 20 per cent.

"Since nitrogen oxide is a primary contributor to the ozone problems, use of this product would have a substantial benefit for Baton Rouge. A reduction of nitrogen oxide emissions of this size may allow our city to avoid taking other corrective actions that are more costly and less effective.

"When I think about the many other cities around the country that also suffer from ozone problems, the potential benefit of this product for air quality is significant. In addition to helping improve air quality, this product has a very important economic benefit.

"Since it produces octane, it reduces the need to

process crude oil. Ethyl estimates this could save over 30 million barrels of crude oil each year. This is roughly one half billion dollars that would not be spent for imported oil each year.

"Since it is compatible with reformulated fuels, it can play a very important role in reducing air pollution both now and in the future.

"I know there are many technical issues that EPA must consider before passing judgement on this application but I want to reiterate some very important practical ones.

"Baton Rouge has a problem today and this product can help us today and it can do so without imposing additional costs or any other burdens on any of our citizens.

"In closing, I think we need to have these kinds of products available as we work to find a solution to our air pollution problems both locally and nationally. The quality of our lives and the very future of our planet depends on our availability to meet the goal of environmental protection in a responsible manner.

"I believe that we must find ways of solving the global environmental problems while satisfying the world's growing energy needs and I believe that products such as Hi Tec 3000 can help achieve both goals.

"Thank you for your time and consideration of this very important matter. If I can provide you with any additional

information, please feel free to contact me."

CHAIRMAN WILSON: Thank you very much and please express our thanks to Congressman Baker for his paper.

MR. DUNCAN: Thank you.

CHAIRMAN WILSON: The next witness will be Dewey Mark. Good morning.

MR. MARK: Good morning, Dick. How are you? It's nice to see you again. Mr. Chairman and members of the Panel, I've provided you with copies of a rather brief prepared statement. I don't intend to read it. I think I'll just visit with you a little bit about this issue.

You know, there's an old saying that what goes around comes around. Strange as it may seem, 11 years ago, in 1979, the refining industry was beginning to seriously feel the impact of the Iranian revolution.

The EPA in the previous September had suspended the use of what we then called MMT or Hi Tec 3000. I was privileged to be on a taskforce that was ... by ~~Tenico~~ Tenneco requesting that EPA permit us to use this additive in unleaded gasoline during the summer of '79 because the industry was faced with potential shortages, particularly of premium gasolines.

The EPA granted such a waiver. I believe Mr. Doug Costle was the Administrator at that time. I find it rather ironic that I'm here 11 years later urging that the EPA this time grant the use of this additive in unleaded gasoline.

I have spent 38 years in this business, I recently retired as president down in Shamrock Refining and Marketing, a medium sized independent company. I'm immediate past president of the National Petroleum Refiners Association so I think I am reasonably well qualified to address this issue from a refining standpoint.

I said that the industry in 1979 suffered the results of a revolution and I'd suggest to you that the refining industry is on the threshold of now even another revolution and that is primarily in the specifications of gasoline.

The refiner's continuing challenge for many years has been to have adequate octanes to meet the ever-increasing appetite that the automobile manufacturers impose upon us and for quite a number of years we had access to tetraethyl lead.

That has since and perhaps wisely been eliminated from our recipe there, so to speak. As we see what's happening now, we're loosing octane by virtue of RVP reduction. Primarily because we must remove a significant portion of butane from our motor pool and this is being continued to be lowered.

We have no idea where the bottom is going to be. It's going to be interesting to see if you can run automobiles in Bangor, Maine on seven pound gasoline but it might be tested even. So we're loosing octanes by reduction of ...

Obviously, when you see the debate that's gone on on the Hill in the last few months, there is a continued effort to reduce the aromaticity of gasoline. This has proven to be a great source of octanes through the years, due primarily to the reforming process.

So we're going to loose octanes by having to reduce the aromaticity. And lastly, there's a very -- a rather subtle double edged sword that's coming and that is we think there's no question that the end point of gasoline, the final boiling point of gasoline will be lowered.

Most of the gasolines in this country have an end point of around 425 degrees fahrenheit. We anticipate that this might drop to as low as 350 or 370 degrees and in so doing you're going to loose a significant portion of the hydrocarbon barrel which contains, in that portion, a fair amount of xylene which is a very high octane blend stock.

So that's the reason I suggest to you that the refining industry is on the threshold of another revolution. It is very difficult today, even in the refining business, to intelligently budget your capital requirements for the future, mainly because reformulated gasoline is an unknown entity.

It gets a lot of play in the media, it gets a lot of lip service on the Hill but if you're a refiner and you're trying to know what kind of capital you've got to request

for facilities that are going to take you two to two and a half years to build, the decision must be made today and you don't even know what the damned gasoline is going to look like because there's so many people trying to influence the recipe, so to speak.

I think that the approval of Hi Tec 3000 is extremely important to the refining industry as a whole. I think also that it has a particularly important significance to the small and medium sized refiner.

When you get up to looking at the cost of octanes in the 87, 89, 92 range, one extra octane number is extremely expensive but it's also extremely important to remain competitive.

There's no question that due to the pricing structure that's been established for this additive, previously unleaded in the country and also for its wide spread use in Canada for the last 10 years, that it is truly a competitive source of octanes and it's primarily on this basis that I would urge that the EPA give consideration once again to approving the use of this additive. Thank you very much for your time.

CHAIRMAN WILSON: Thank you very much, Mr. Mark. While we're visiting maybe we can get your advice on how we should proceed. I think obviously this additive is attractive in many ways. It's an effective way of

increasing octane and apparently has the effects of lowering emissions of nitrogen oxide and perhaps carbon monoxide as well.

Unfortunately, we never find an issue that doesn't have some cons as well as pros and as you mentioned, we've been through some of these issues in the past, like lead, where perhaps it would have been better had we never gone down that path at all.

We've heard already from Ms. Silbergeld this morning about her concerns about the introduction of manganese in the environment, another heavy metal. The additive does appear to increase hydrocarbon emissions slightly.

Also we'll be hearing, if not today, I'm sure written comments, concerns about the impact on ... of deposits of this and what's your advice on how we should weave our way through these issues and make a considered judgement?

MR. MARK: Well, Mr. Wilson, I think that one of the things that we should not be blind to is the extensive use over 10 years of this product in Canada, at, as I understand it, a dosage level twice of what is being requested in this waiver.

I think that the EPA should use its intergovernmental contacts to the fullest extent to get our Canadian friends to share their experience with us.

I don't know anything that's better than 10 years of

experience as opposed to people sitting around and speculating about what if. You know, any issue, anything that comes up, somebody is going to say what if. Then you've got to measure the probability of that what if and then you've got to measure the cause and effect of that what if.

I'm always reminded of -- it's a redundant story, but the Alaska Pipeline. We had people worrying well, what if the caribou won't walk under the pipeline? They raised it, it was in the air. There are more caribou in Alaska today then there were 15 years ago but the net effect of that, it delayed that project -- that and others -- delayed that project by eight or nine years and just ran the cost up astronomically. So I would urge you to be very dependent upon the Canadian experience in this case.

MR. ATKINSON: I have another question or two for you, Sir. One of the goals, if you look at the House and Senate versions of the Clean Air Act are that -- you mentioned the recipe, one of the items in the recipe is to lower aromatics.

The oxygenates have gotten a great deal of attention for, among other reasons -- a number of reasons but for one reason in particular, to offer as a substitute for the octane that would be lost if we were to lower the aromatics.

With the octane potential of MMT or Hi Tec 3000, if you

prefer, what do you believe the competition effects would be on MTBE, ethanol, some of the oxygenates?

MR. MARK: I guess the place to start from is the first oxygenate that was used by the United States refining industry was MTBE, not ethanol. It was MTBE. It was introduced because it could be produced and was more than competitive with ~~tyaquine~~ toluene which was an old-time aromatic octane enhancer, if you would.

As time has passed, a number of the western states, particularly, have imposed a minimum level of oxygen in the gasoline, particularly during the winter months. So MMT and ethanol have afforded an opportunity to meet those oxygen requirements, which was independent of an octane imposition. It was strictly an oxygen containing issue.

My own conviction is that if EPA grants this waiver, MMT will be put into the blending stream first, along with straight run and other blend ~~stuffs~~ stocks that go into it and then the oxygenates will be used along with whatever aromatics are permissibly useable to attain the ultimate octane.

So I think a refiner would be stupid, due to the competitive advances, not to use it first and use it to his fullest -- you grant a 32nd of a gram, then use a 32nd of a gram. And then they'll finish off with either oxygenates and/or aromatics.

The oxygenates are not the final answer. Believe me.

You've still got to have other sources of octane to meet an 87 or 89 octane product. You just can't do it with oxygenates.

Ethanol, for example, is 10 per cent. MTBE is limited by your waiver to 15 per cent. So you can't make an 87 or 89 octane gasoline just resorting to octane enhancement by oxygenates.

MR. ATKINSON: In Canada I'm told that virtually every drop of gasoline has MMT in it -- or every gallon. What I'm hearing and you seem to think that will be the situation in this country also with this waiver, is that true?

MR. MARK: I think the economic advantage of the use of it will drive it in that direction. I think some of the testimony that has been presented in the written form indicates that the cost of this additive is around eight to ten cents per octane barrel.

I can tell you my own first hand experience in refining, that our cost of an octane barrel for reforming is a minimum of about 25 cents a barrel and I think on an average of the industry it runs about 35 cents a barrel.

So as a refiner, a guy would be stupid not to use a 10 cent a barrel octane source as opposed -- he can lower the severity of his reforming and that is money in his pocket. Plus the fact he would get an increase of liquid product

yield if he can reduce it.

See, in the reforming process you actually destroy a portion of your feed stock. A portion of it is converted to very light hydrocarbons that either are recovered or they go into the ... system.

Well, now, if you can change the amount of liquid product that is produced by reforming by not having to resort to higher severity to get those extra octanes, then you're ahead of the game. Does that make sense?

MR. ATKINSON: Yes. Thank you.

CHAIRMAN WILSON: Thank you very much for joining us. It's good to see you again.

MR. MARK: Thank you, Mr. Wilson. It's good to be with you again.

CHAIRMAN WILSON: The next witnesses are Mr. Everett Hodges and Dr. John Donaldson.

MR. HODGES: Mr. Chairman, I think I'll lead off here. My name is Everett L. "Red" Hodges. I'm an independent oil producer from the state of California. My interest is from some research that I started sponsoring about six years ago in the state of California so I want to kind of give you a story of the history of the reason I'm here and why my interest has developed around manganese and manganese compounds.

My wife and I have four children, three are adopted and

one of these adopted kids was hyperactive and out of control. This was about seven years ago. So I read an article in Science News where some researchers out of Argon National Laboratories up in Chicago had stated that they were able to discern that aberrant behavior could be detected using sophisticated equipment and hair analysis and with toxic loads of heavy metals they were able to do a significant comparison of people that were normal versus hyperactive people.

So I called them up and being an independent oil producer in 1979 and the price of crude oil was about $25 a barrel out in California so I was a hell of a lot smarter now that it's down to $9 and $10 a barrel.

But I figured since I've got the cash flow and I want to fix this kid of mine because he was giving me a lot of trouble, I'd sponsor a research project and I was sitting on a foundation with some professors at the University of California, Irvine, notably, Dr. Lewis Gottchalk who has written 850 scientific peer reviewed articles and published 45 books and I was told that if you're ever going to do any double blind research to prove whether or not the theory of these guys is going to pay off, you have to get a world class scientist.

So I asked Louie if he'd be the lead agent and I'd talk to these fellows at Argon and they said well, they'd gone so

far but they had no more research funds, therefore I offered to sponsor the program. Gottchalk said yes. He said I'll set up a protocol and we'll do the job and I said what I'm really after, Louie, is do these fellows have something with regard to being able to detect severe mineral imbalances, chemical imbalances by a simple non-invasive use of hair so that you can discern that people with -- providing this service to a doctor, let's say, could know what the problem is if somebody had aberrant behavior.

So he said sure, I'll sponsor the deal. He said quite frankly, Red, he said, you're trying to tell me that there's a physiological marker for violence or aberrant behavior and he said, let me tell you something, I've raised $30 million for the university and done these 800 articles and you're trying to tell me that there's a subclass of people and that if you were to discover that there was some kind of a marker for aberrant behavior, it would put a question on scientific research on all of the scientific, physiological studies that have ever been done.

I said well, I don't know what I'm saying but I want to spend the money. He said well, Hodges, you're pissing your money away but that's okay, let's go for it. I said all right, let's go for it.

So he sets up the protocol. We go -- Dr. Bill Walsh out of Argon National Laboratories had a friend by the name

of Schoenthaler who had access to the prison system and obtained access of hair samples of 100 criminals in this prison system. I had a Superior Court Judge that collected those hair samples along with 50 controls that they mixed up and the judge held the keys to the code. UCI came down and just got the 150 hair samples but didn't get the keys to the code, went back, put in 50 more hair samples, mixed them all up, recoded them, gave them to the Superior Court Judge who held the key to the code and then forwarded the hair samples of approximately 200 to Argon National Laboratories who then recoded it again and sent it off to Doctors Data which is a commercial laboratory in Chicago that does hair analysis.

The results come back, five to one. Gottchalk says Hodges, this is bullshit. I say why do you mean? He says this is impossible. Hair is no good although by then I knew there was two thousand scientific articles on hair alone just on lead. Peer reviewed. But these guys don't know about this stuff.

So he said this is impossible and he says I can't write a publication. I said well, I paid the university $25 thousand for the protocol, what do you mean you can't write a publication? He said I didn't allow for violent guys outside the institution and it's quite obvious that these heavy contaminants are coming from the institution. They're eating out of pots and pans loaded with heavy metals.

So he said I'm sorry, I can't write. I screwed up, but you know, you're wasting your money. Well, I knew that two sheriffs in Los Angeles and San Bernardino County, Fred Bland and Sherman Block and I had been communicating with him.

Gottchalk went with me, we went up and saw Sherman Block who has 20 thousand people in jail and the thrust was this. Since he's alleging that there is an institution factor in the hair because they are locked up, let's get guys that just were committed a week or two ago of violent criminal behavior and get them and get their hair sample right then.

So we paid these criminals and these violent guys $10 a piece. They'll kill for that. And we got hair samples from the two different jails. In came the hair samples directly from the two jails to the department of psychiatry. They went out and got 30 controls, mixed them all up, sent them back to Argon who coded them, came back six to one.

Now Gottchalk is having a problem. As you can imagine this guy, he's 65 years of age, he's spent millions of dollars and here he's finding that there is a subclass of people that seemed to have some kind of overloads of metals accumulated in the body.

Well, he says, I can't do anything about it. He says, I've got to publish. So we call the guys at Argon National

Laboratories. They sent down a formula and their formula wasn't working. It might have worked in Chicago when they did their work but it didn't work in California.

The guy was telling me in essence, well, it takes a trained eye to find out, usually, to look on these hair analysis. You've got one there on a mass murderer and you can see how aberrant these scales are of these guys that are violent.

So I've got a computer jock in the office with me. I also spend to money on a computer hotshot deal. He put all these hair analysis on his computer and he was asking the computer what element is it of the 30 different elements that they analyzed which is one standard deviation high in all three of the studies, the two jails and the prison and it came up manganese.

I said manganese. He says yeap. Lead doesn't count, cadmium doesn't count but he says manganese in all three of the studies.

I go over to Gottchalk, I said Gottchalk, manganese is the only one that's one standard deviation high. He says Hodges, this is a post-doc finding. We'll have to go back to jails but we'll now have a protocol. We predict that there will be a significant number of violent individuals with one standard deviation high of manganese which is .7 of one part per million versus controls and we were running six

to one at this point in time.

We go back to jail, he picks up 30 hair samples with the Department of Pharmacology, a guy by the name of Pasio Rubello, comes back, goes out and gets 60 controls, mixes them all up, sends them back, it comes back six to one manganese.

Now Gottchalk has got the sign. He's a christian. He's a believer. And by the way, I'll give you a copy. He just submitted a journal -- a paper to be submitted and printed in the Journal of Neural Toxicology.

Following this, Sherman Block in Los Angeles County asked me to go down and get -- no. I asked him if I could go get some other hair samples out of the state of California. The jail in Houston, Texas, gets hair samples of 30 individuals -- and by the way, on these first four studies -- the first three studies, one-third were black, one-third were hispanic and one-third were caucasian so there were 155, all races were balanced. The 30 with the protocol of manganese was all caucasian so we went down and got all black in the San Bernardino Jail. In the Houston Jail 80 per cent had one standard deviation of manganese.

I went down into the Louisiana jail system, 45 per cent Louisiana. Not as high as the rest of them. But I didn't get controls.

I'm doing this stuff and I'm reading articles about

manganese intoxication. By the way, I don't have a degree in anything. But I'm freely espousing now on criminal justice, psychiatry, the court systems in research.

Following this, I'm reading these articles and the name John Donaldson keeps cropping up with regard to neurotoxicology so I called Donaldson. This was approximately a year ago. I give him this story about what we're finding out here in California.

Donaldson says my god, so that's it. He doesn't remember this but I remember this and I said what's that. He said Mr. Hodges, I'm sending you an article where the national government of Australia noted that there was a significant incidence of violence on an island off the north part of the country, out in one of the oceans and he says they went out there and did a manganese study but they were sent out there because of violence. It's the world's largest manganese mine. Groote Eylandt. Incidents two, three -- a hundred per cent higher than the basic continent of violence and that's why they sent Dr. Countenter out there.

You have before you there a list of documents that I've put some roman numerals on. The first one is Senate Bill 107, State of California has passed a law that allowed biomedical research in the Northern California Youth Authority. The Governor signed this by virtue of this

research work.

The next one is a four page summary of the research signed by Dr. Gottchalk and Robello at the University of California which in essence gives you a rundown on the study and the double blind of the four criminal justice systems.

The next one is a news article on Patrick Purdy, who is a mass murderer. We got his hair sample. Patrick Purdy, he -- the State Attorney's office got the hair sample. They sent it directly to Doctors Data. He had two and a half standard deviations high in manganese. There's his hair analyses. You can see he's extremely overloaded on all the metals. That's number four.

Number five is using hair as a diagnostic tool to compliment blood serum and urine. The next is an excerpt from this book here I'll give you. This is Manganese in the Canadian Environment. It's published by Canada. Most of it has Donaldson's work in it.

The last one is a judge five years ago got hair analysis on 16 juveniles in Louisiana, 15 of 16 had one standard deviation high on manganese and over half of them had two standard deviations high.

I don't want to shoot Ethyl in the foot but I don't want to be blind sided. As far as I'm concerned, from the research that I've done here, there's a lot of research that has to be done. It's primarily with primates. Pregnant

primates, by the way, because from Donaldson's work and others, manganese can go right through to the fetus.

However, there can be a -- it looks as though there's a class of people that have a propensity to grab on to all heavy metals including manganese and it can be genetic and it isn't going to take much to prove or disprove it.

If this is the case, you can see that it wouldn't make any difference where the manganese came from, these people just grabbed on to it. It was pointed out here that over 50 per cent of the people, kids in the inner city are deficient in iron. If you're deficient in iron, the gut grabs on to -- guess what? Manganese. The first thing it grabs onto and it puts it into the body.

Donaldson will get into the technical aspects of what happens when manganese gets into the body but as far as I'm concerned, the effects of manganese and what's been taking place has been sorely and pathetically overlooked by the Environmental Protection Agency.

You people are dealing with a time bomb. Unfortunately, the time bomb has a tenant 30 year fuse on it because if people from the research generate this and it causes early deterioration of the basal ganglia and ... and it doesn't happen until 50 and 60 years of age but it's taken place by virtue of an overload of manganese, then the EPA and the school lunch programs ought to see that iron is

supplemented in the lunch meals to get these kids so that they're not grabbing on to manganese.

That pretty well does it. I think that the EPA should get on this, study it in depth, sponsoring the necessary programs to find out what manganese is doing. It's a very insidious metal but it's a very interesting metal and one thing that's fascinating to me is that manganese 2 which is relatively inert in the human brain can change as valencies to manganese 3. If that takes place, it becomes a highly neuro degenerative chemical and if it's destroying portions of the brain it is ascertainable by using primates and getting on a double blind cross over study.

So I just -- as far as I'm concerned, I think the Ethyl Corporation can't -- look at, I'm in the oil business. I'm all for selling oil. In fact, if you know anybody that wants to buy about three thousand barrels a day of California heavy high sulphur crude, have I got a deal for you.

(Laughter.)

In fact, if you want to buy that, I have a bridge I'd like to sell you, too. I'd just like to see the EPA move on this very cautiously. The state of California, through Senator Bob Presley, who is Senator of the State Finance Committee but also in charge of prisons, looked at this and assigned it with scientists for five straight years before

he introduced his legislation.

When he got on the floor of the Senate and Assembly there was only one vote against it in the Assembly and none in the Senate. I mean, it breezed through there. You couldn't get into the California system to do this neuro -- these kinds of studies, the supplementation studies and use hair and blood for 10 solid years it had been outlawed. They're serious now.

Of course, California is like everybody else, we've got 90 thousand guys in the prison system. We have 10 thousand kids in the California Youth Authority, 50 per cent of them ... within 24 months. They cost the taxpayers a million dollars a piece.

If we've found physiological marker for violence, even if the manganese doesn't cause the violence but it's a marker that is associated on a five or six to one ratio, then I'm claiming that we've got the world's first physiological marker.

Now, every institution that we've been in that they have controlled and nobody has touched these samples except the University of Southern California or the judge or Donaldson in Australia, is coming up with a manganese marker in violence.

The question mark, it may or may not be the cause but there's certainly something there and I'm looking for a

situation where we can go in and do an investigation where the manganese isn't a marker and I've challenged a half dozen prisons but the bureaucracy doesn't even want to bother with it.

I think right now manganese is the name of the game. The Ethyl Corporation has got something that would be of great benefit from the standpoint of energy saving by decreasing consumption of oil but they need to do some more basic research so that they can get on with finding out as to whether or not it's a certain class of people. It doesn't matter whether they get it in water, which people get intoxicated with water, dust from mining or from food, you can pick up manganese from a lot of different areas and it doesn't make any different were it's coming from, you're going to get it and therefore it could be that it's not a matter of ... but as far as I'm concerned, the EPA should walk very cautiously before they make a decision to approve this.

Now I don't need to introduce John Donaldson but he was appointed by the Canadian government to investigate and comment with regard to manganese in the environment. He's published throughout the world and I've asked John to come here today because he can handle the technical aspects of the manganese question. Thank you.

CHAIRMAN WILSON: Thank you.

DR. DONALDSON: Good morning Ladies and Gentlemen. You know, when I first began acquainted with manganese back in the '60's, the first thing that I recall was the definition, actually, which comes from the origins of the ancient greek manganin which means voo-doo or cult, black magic.

After about 25 years experience with manganese which has excited me, frustrated me, which has lead along the golden path of many promises and provocative glimpses of the underlying biogenesis only to feed me with really what amounted to fraudulent rhetoric where I was once again dashed to the ground again when I thought I had the answer to this extremely provocative metal element.

I'd like to set the stage, if I may, actually, for my acquaintance with manganese. This was in the laboratory of Dr. Andre Barbeau at the University of Montreal where I became Director of Research on the task which had been set to us, actually the underlying issue of Parkinson's Disease.

It's difficult to reconcile manganese without also understanding a little bit about Parkinson's Disease. I'd like perhaps this morning to go into that a little bit and all you can really fully comprehend the underlying mysteries of this most remarkable element.

The story of the manganese, the old story and the new story is a fascinating saga and has really yet to be told

but at that time, actually, we were working on trying to find a drug which would cure Parkinson's Disease. Parkinson's Disease, as many of you probably know, is exhibited by facial stiffness, rigidity, tremors and through ultimately the work of Dr. Hornylcienicz in Vienna and other neuropathologists at the University of Vienna, we discovered that there was a deficiency of the neuro hormone dopamine -- dihydroxyphenylalanine, dopamine -- so many efforts were made around the world to try and find a way to replenish the dopamine in the basal ganglia, a region which was deficient in dopamine.

It was quickly found that dopamine itself would not cross the formidable blood brain barrier by which means chemicals are occluded from penetrating the brain for very obvious reasons.

Ultimately, we started to look for precursors of dopamine. Now, one of the precursors used widely today -- still widely used after 25 years -- is dopa. This is a nutrient. Dopa, El Dopa is administered to patients as dihydroxyphenylalanine as a direct precursor of dopamine. This goes on, in the brain and replenishes the dopamine and the patient is directly benefited. There are other drugs now available which do essentially the same thing, to replenish the dopamine.

Our direct competitors in this were the very gifted

individual Dr. George Cotzias in the Brookhaven Laboratories and Dr. Cotzias, whom I admire very much, died in 1977. Dr. Barbeau died four years ago. It was well known in circles that both Dr. Barbeau and Dr. Cotzias, who had worked and been credited with the discovery of El Dopa, that they would have been awarded Nobel Prize, but this prize would have been awarded jointly rather than singly, so when Dr. -- when George Cotzias died, this sort of went by the board.

But this is to give you an idea of the -- very much the high intensity of research which was being conducted at that particular time in Montreal and in New York in the search for a cure for Parkinson's Disease.

As one does, one looks for clues, as an investigator and I'm a basic minster of neuroscientist. I was impressed with the work that Dr. George Cotzias had done on manganese. His studies had shown that in Chilean miners who had been exposed to manganese fumes in the mines, they came down with essentially what appeared to be the clinical signs of Parkinson's Disease.

In a case that went through autopsy they found that this individual exposed to manganese in the mines also had dopamine deficiency in the basal ganglia, the same reason as Parkinson's Disease.

This, to me, seemed a major clue in which to possibly unravel the mysteries of Parkinson's Disease. Here was a

metal element which could effect the brain to produce a certain methodology and a biochemical pathology of Parkinson's Disease so this is when my love affair began with manganese.

The other peculiar thing about manganese and left completely in the dark for many, many years was, unlike Parkinson's Disease, there was an acute face to manganese neurointoxication.

This was a peculiar, bizarre neuro-psychiatric symptomology which was exhibited by running, laughing, chasing after cars, very bizarre type of psychosis. Manganese psychosis. We gave it that title although we still don't know what it means but certainly very much in line with the origin, again, of manganin, the voo-doo. The name attributed by the Greeks to manganese. It's still very strange.

My first attempts to uncover the rational underlying the ability of manganese to cause insult to nervous tissue in a very remote area were fruitless for many years. The most puzzling thing was the fact that manganese administered to animals, despite the fact that it would locate in areas of the brain such as the cortex in very great amounts did not cause any damage.

For many years we wondered why animals did not make a good model for this thing until ultimately it was revealed

that primates could be used to determine the effects of manganese on an area called the substantianigra.

(Tape malfunction, information lost.)

... discoloration, loss of the black melanin and pigment in the back of the brain and he knows without looking, almost without proceeding any further, this patient with Parkinson's Disease and he can always tell, with many years experience, of the degree of depigmentation the extent of the Parkinsonian symptoms that the patient actually had prior to death.

The depigmentation, the loss of pigment, the loss of melanin from the granules contained within the dopamine aryans, all the substantianigra, this region we now know is very intriguing. It contains the cells which synthesize dopamine. These fibers in the back of the brain then send up the dopamine to be stored in the basal ganglia, in the cardia putamen region of the basal ganglia. This area, as we mentioned, is diminished, is depleted in Parkinson's Disease and in manganese neurointoxication.

In a few studies in primates and one study in man and by personal observations by Dr. Hornylcienicz in Vienna, Dr. Hornylcienicz has told me and Dr. Hornylcienicz is one of the pioneers in Parkinson's research, he's one of the pioneers in the neuropharmacology along with Bertheimer and Jellinger in Vienna in neuropathology that manganese

neurointoxication is the ideal model for the study of Parkinson's Disease.

There is depigmentation, he tells me, loss of the melanin pigment, in the cells of the substantianigra, which of course would indicate also us having found loss also of the dopamine in the basal ganglia since the cells are destroyed that synthesize dopamine, it stands to reason that it's not going to be stored.

Barbeau, in 1962, published a paper in which he stated that Parkinson's Disease and possibly other neuro-degenerative disorders like Ametropic Lateral Sclerosis, Alzheimer's Disease, Huntington's Disease, possibly, were essentially disorders or exaggerated aging ...

... above the basal ganglia, above the substantianigra is there is an age related decrease in destruction of these cells in substantianigra.

Approximately -- and there is some disagreement on this, but for ours purposes, approximately seven per cent destruction per decade is what is agreed on by the UK, UBC and Canada. That is seven per cent lost cells so that 50 years of age you've lost half the neurons and the substantianigra. There's destruction. There's great compensation, obviously.

Parkinson's Disease occurs when you have 75 to 80 per cent destruction of those neurons. This is an absolute.

But consequently, one of the major theories in leading edge neuroscience which relate to environment today is that there are agents, neurotoxins -- insidious neurotoxins like manganese which are age accelerating neurotoxins.

These agents have the ability to speed up the normal attrition which occurs in the substantianigra. In other words, instead of seven per cent, perhaps in the womb, in utero, perhaps peripherantially since manganese attacks peripherantially developing tissue, that is the fetus and younger children are peripherantially vulnerable to manganese, that one would have an accelerated attrition rate so they may have -- instead of 20 years of age a 21 per cent destruction, this could be an insult by a toxin -- an age accelerating toxin -- which would produce like a 10 per cent. Perhaps at 35 years of age they also have another insult by another toxin which again produces another acceleration so consequently, at 50 years of age, they now have 75 per cent destruction of the substantianigra.

Currently, as you can well see, there are no methods apart from nuclear medicine which can really address what the rate of destruction is in the substantianigra of any individual.

To my mind this is one of the paramount problems addressing occupational toxicology and occupational health risk, the ability to evaluate as can now be done using spec

imaging. Single photo ... and computerized tomography. This is the poor man's PET scanner which allows hospitals over $100 thousand, using sophisticated radio pharmaceutical molecules to determine the degree of destruction in the substantianigra, to evaluate the age acceleration in any individual.

I believe that manganese is such an age accelerating neurotoxin and I believe this is the answer to manganese's ability to produce biochemically, pathologically and clinically the picture which is very similar -- very similar, but not identical to Parkinson's Disease.

The ... effect which was very peculiar and still is a mystery is the psychiatric manifestations of this. The more I worked with manganese, the more I became convinced that this particular metal could not be toxic. There was no rational to explain why in 1837 James Couper in Glasgow examined workers who had been industrially using manganese oxides, grinding manganese ores and he came out with two papers in Nature in which he stated that manganese had the ability to produce in these workers a gait, peculiar muscular incoordination, psychiatric symptoms and loss of libido.

The three classic symptoms associated with Parkinson's Disease -- with manganese neurointoxication, that is the unilogical picture, the psychiatric picture and the

it does not necessarily, nor does it follow neurotoxicologically ... occur. This cannot be used.

This was inexplicable to me for many years until, like most things, we look back to the work has been done earlier on and I came across some work that have been done in England way back in the early part of the century where this individual had been administering manganese -- excess manganese to plants and he found that the ~~leave~~ leaf portion, a particular portion of the ~~leave~~ leaf exhibited neurosis. It was brilliant biochemistry for those days, he extracted the manganese from that particular portion of the leaf which was intoxicated and he found, to his astonishment, that the manganese he had given which was manganese 2 which exhibits a number of valences, five valences to be precise, that the manganese he extracted from the leaf was, in fact, manganese trivalent, Mn3, and yet he'd administered Mn2.

This, to me, was a major clue, I feel an unraveling as to what manganese was doing in the brain and explaining why manganese was only localizing to a very tiny area of the brain. I considered that you get huge amounts of manganese and very little happens, perhaps the basal ganglia, the substantianigra presented manganese with the unique environmental biochemical milieu by which it could be oxidized to a higher valence form, that manganese in fact living up to its name, manganese and voo-doo, was, in fact,

exhibiting the faces of Janus. One side malign and one side benign.

The Mn2 form, as we know it, a ubiquitous metal, benign metal. It has all sorts of good things and the more I know about manganese, which is not very much, which is derived, I can assure you, from the gifted work which has been done by Cortzias and others long, long before, frankly I think that the ability of manganese to induce insult is due to its ability to be escalated to the higher valency form.

This theory falls with a number of papers and it has since been confirmed by other workers, particularly Dr. Archibald.

So that my theory actually tells of manganese neurointoxication is you have to address it in those terms. It's ability to be escalated to higher valency forms and when one talks to toxicity you have to look and ensure that it's actually the trivalent form in fact that you're looking at.

This would explain as to why manganese localizes and attacks specifically a nucleus. A nucleus which contains the brain's highest content of peroxidase, which has the ability to oxidize manganese, is the highest content also of lipid peroxides, ... fatty acids and also this whole milieu which is contained in that region provides the necessary environment in which manganese trioxide -- manganese --

trivalent manganese can actually flourish and do its damage to that particular region.

In terms of the psychiatric effects of manganese, I believe that the trivalent form is able to alter the binding of the ... neurotransmitter, dopamine neurotransmitter in the putamen, in the basal ganglia. This would occur -- this is the peculiar thing, why does acute phase in miners. We have this acute phase, this psychiatric problems which disappear and then they come down with Parkinson's Disease.

The acute phase only lasted about six months, according to George, and this is explicable in the fact I consider where you're getting escalation and de-escalation between the various valence states of manganese and manganese three form or perhaps even manganese four form has the ability to block the binding of the ... dopamine receptor in the basal ganglia and this has been considered possibly involve -- this particular receptor, in psychiatric disturbances and schizophrenia. This has yet to be addressed.

The effects of manganese on the reproductive system would act actually similarly, through the neuroendocrine nucleus ... and the hypothalamus. Again a specific localized nucleus.

All of these nuclei have the ability for very, very high energy. These are areas where maximum energy, maximum oxygen consumption is taking place. Manganese toxicity

occurs not because of access in that sense but because of paratervation of the normal physiological role which is undertaken by manganese. That's a story we cannot go into here but like most things we find as we enter and look at nature and biology, we find that how incredible it is is that metal ions, actually, and things which would serve a physiological function, when we see the toxicity, it's only within a very narrow range at very tiny amounts, like selenium. A doubling of selenium produces profound neurotoxicity. So again manganese exhibits a similar sort of thing.

There are exacerbating factors, also. Iron deficiency will produce pronounced manganese toxicity. Calcium deficiency likewise. These metal ions seem to act as gatekeepers in holding off the -- in holding down the escalation of manganese to the higher valency toxic species.

I was intrigued a couple of years ago in manganese study, a call to go to Australia where there's an island called Groote Eylandt discovered by the Portuguese some years ago at the northern territory of Australia and the individual there, Dr. Cawte who is a transcultural neuropsychiatrist who did work with the aborigines for many years and he was surprised to find that there was considerable violence exhibited among the aborigines in this region. This very remote region. Also, I was intrigued

with the fact that he mentioned that Groote Eylandt contained the site of the world's largest manganese mine, owned by BHP Associates in Melbourne, Australia.

But most importantly, I was extremely intrigued when I looked at the map of the location. The basic neuroscientist depends on the epidemiologist to give them clues as to what -- where diseases are occurring and where there is a ... of these diseases. This applies also to neurodegenerative diseases.

One of the things Dr. Cawte has been working on and ... and others in the NIH for many years is the prevalence within the South Pacific of Alzheimer's Dementia, Parkinson's Dementia and ALS or Ametropic Lateral Sclerosis.

This has been localized, clusters of cases in the key peninsula in Japan and the Island of Guam and Southwest New Guinea. They have clusters of these cases and they have looked at the environment, there has been a number of possibilities put forward. One has been manganese and one has been aluminum in the soil. But the interesting thing about all these areas, actually, is there's a calcium deficiency in all the regions.

So when I looked at the map I was delighted to find Groote Eylandt -- this lay 200 miles actually further south of New Guinea and if one drew a line between the key peninsula between Guam, between Southwest New Guinea and

between the Island -- Groote Eylandt -- it runs 137 degrees longitude, which is quite staggering.

When I was on Groote Eylandt I had an analysis done of the water. I swam in the river water where I stayed and this was -- what really astonished me was how soft the water was and there is virtually no calcium in the water. The other water was the same. There was no calcium in the water. For us, in this part of the world, this is quite staggering to find water which doesn't have any calcium or magnesium salts in it.

Under those conditions, this renders manganese particularly toxic. As I've mentioned earlier, the lack of calcium which acts as an ion antagonist, occluding and keeping manganese under control, controlling its valence. So this is very significant in all these areas.

This is obviously an area of great interest in terms of the neurological symptoms that were occurring in the aborigines. It's a difficult area because this area is not open to Australians, it's run by the aborigines themselves but Dr. Cawte has access to the area because he's a member of the community, having worked with the aborigines for many years.

The area, I found recently, to my astonishment, again lending credence to the occult origins of manganese, I just recently received from the Australia National Library the

log of Captain John Flinders who mocked ... the british navigator who was sailing the HMS Beagle, the same ship which was used by Darwin to devise his theories on the origin of the species. The HMS Beagle travelled all around Australia and the thing in the log which is most intriguing is that he remarks on the aborigines in Australia very greatly.

He came to an area which he, because of the presence of these enormous nodules he called Blue Mud Bay. Blue Mud Bay is very close to the site where BHP has it's manganese mines. Blue Mud Bay, of course, refers to the manganese nodules. An area of enormous deposits of manganese.

In his log he recalls also that unlike other islands close by, within 50 to 85 miles, the natives of Groote Eylandt and Blue Mud Bay had sent their wives and children away and exhibited hostile behavior and aggressive behavior.

This I thought very intriguing, actually, since this was 1805 and -- through 1837. Very, very interesting point and so when Mr. Hodges actually had called me regarding the ... nature of manganese in relation to violence, I was very intrigued.

Studies are progressing, actually, on Groote Eylandt and much more work is needed to determine in fact does manganese have the ability to produce a violent state. I have no conception of whether this could be done or not but

it's a very interesting problem.

Again, we have with manganese all these associations and like most things, the research needs of this remarkable ... have never really been addressed.

In relation to Ethyl Corporation and their submission today, frankly, I'm mad and this is the reason I'm here. I'm mad because they have had ample time to address the research problems in this area.

I was asked to meet and to write about the health effects of manganese, essentially in minuscule form I published in that paper, in that document essentially more or less what I've told you this morning.

That is, the ability to look at manganese intoxication from this insidious viewpoint as a neurotoxin. It has the ability to escalate through several valence states. The aerosol route is the most profound neurotoxic route.

The possibility that it may be involved in alteration -- in altering neurotransmitter binding in the central nervous system. The most important priority, of course, is to establish in primates whether, in fact, manganese is an age accelerating neurotoxin and to me this is the pivotal problem in relation to manganese.

I discussed these with a representative from Ethyl Corporation no less than four years ago. Ethyl Corporation were also given a copy of the Health Effects document which

has been published so they could make and address these possibilities.

I've seen the document which has been delivered to the EPA in reference to their submission to support their waiver. I find this document specious for a number of reasons.

They use old data, it's filled with essentially utopian rhetoric which does not really address anything. It puts on blinkers. People are sitting there and they refuse in a paranoid way to see anything beyond what is favorable and what is utopian in relation to their particular case.

It's not just that manganese is an insidious neurotoxin, the fact is that manganese is representative of a number of other neurotoxins and as such should be addressed by your body in this regard.

Your body should be cognizant of the fact that we now have new class toxins which threaten health on the long term basis. These problems are fraught, obviously, with great technical difficulties but they're not insurmountable and EPA has surmounted greater difficulties in the past, I believe.

I believe this is a challenge to your organization. I think it's incumbent on your organization to ensure that this research is conducted so that 20 years along the line we're not looking back and saying of course, these are age

accelerating toxins. This is essentially why this thing occurred. Because we released these into the atmosphere, we did not address the possibility that there was different oxidation states which could cause different problems in the selective nucleus in the central nervous system. Despite the fact that one has a thousand times greater concentrations. There are premises which are set, obviously, in scientifically valid data, do not necessarily follow in all cases.

I challenge you gentlemen that manganese lives up to its occult origins and this should be taken to you as a challenge, to ask Ethyl Corporation to conduct this research, to have it conducted in good establishments by reputable individuals. That's all I ask and that's why I'm here today. Thank you.

CHAIRMAN WILSON: Thank you very much. Could you give us the status of what the reaction was to this document within your country, Canada, and what the status of using MMT and the experience has been?

DR. DONALDSON: Not only is manganese a stealth neurotoxin but I think also the political economic abilities in which manganese is marketed also rubs off on particular individuals marketing it.

I have -- I'm frankly astonished, actually, but frankly, Canada does not have the neurotoxicology back up to

address the problems which I've already pointed out to the Canadian government.

They consider that these are valid problems but in terms of neurotoxological evaluation of the issues which I have raised, they're technically incapable of doing this at present.

They have also, like our individuals, they have used the data -- previous data conducted by the World Health Organization and others to come to their conclusions on this. But as I mentioned to you this morning and I hope I made this point across, you cannot see manganese neurointoxication without also being cognizant of neurodegenerative diseases like ALS, like Alzheimer's and like Parkinson's Disease and being aware of leading edge achievements in neuroscience and this is the way manganese has to be addressed. We don't have the personnel or the technical capacity for that.

MR. POIRIER: Dr. Donaldson, in item number four and also the item number seven you included some hair analyses and you said that statistically analyzed and you found that manganese was pulled out as the sole element causing these violent behaviors.

What kind of statistical analysis was performed and -- because just doing a cursory look over some of these profits I also see significant increases in a lot of the heavy

metals and I was wondering also if this has strictly been on hair analysis or whether or not it's been correlated to what levels of the various heavy metals or minerals.

MR. HODGES: To answer that, first of all, there are four or five different articles with regard to blood manganese because -- that conflict with other -- because they're talking about 15 parts per billion in normal blood serum manganese and it's tough to get something to correlate so that there's never been, to my knowledge, a competent double blind study taking blood manganese and hair and seeing if there's a relationship.

We are playing around right now on a mini study to verify whether or not we have the super oxide dispitates. I'm beginning to sound like John Donaldson here. Protein marker in here relative to blood.

We've got 10 samples of violent kids out of California Youth Authority. Four of them had elevated manganese. They are 17, 18 years of age. We're taking the urine and the blood and the hair and seeing if we can find the specific protein marker in the hair that would confirm and relate to elevated manganese.

If we have it, then the argument with regard to the viability and the integrity of using hair analysis is all over because the entire medical profession -- if you can get the one protein marker that's in the hair, then we've got a

marker but right now hair analysis has had a bunch of bad press but we now have Dr. Gottchalk, Dr. ... who is on the National Institutes of Health as one of the co-authors on the paper that has been submitted to the Journal of Neurotoxicology. Hopefully it's going to get published someplace in the next few months.

This will be the first time where there's been extensive in four different institutions, all double blinded, something to relate to a physiological marker for violence.

If we know what the problem is with regard to this criminal justice problem or at least, let's say 50 per cent of the people, then we can start attacking what it is that these people need that have the propensity to gather up the heavy manganese, lead and so on.

Manganese is the only element that we could find in all of these institutions that was consistently over one standard deviation high. Lead would be at one institution and not in the next. Cadmium -- we got ~~hair~~ hair samples on 12 serial murderers. I mean, bad, bad hombres. Eight of these 10 guys have extreme imbalances.

Simonson in Missouri that killed his family. Way off the way with regard to sodium and potassium but his manganese and lead and cadmium were okay.

Hubertey who murdered the 21 kids at the McDonalds

hamburger stand in San Jacinto five years ago, the highest lead cadmium of 100 thousand hair samples that were in the computer.

Hubertey -- the reason I went after Purdy was because Purdy was also a welder. Hubertey was a welder. Shot guns down in his basement that was unventilated. Got the hair sample. Extremely high lead and cadmium.

We went to Purdy because I heard Purdy, who shot and killed -- I think it was six children in a grammar school -- was also a welder and loved guns and I predicted he'd have high lead and cadmium and no manganese. He had high cadmium but he had 2. plus standard deviations of manganese.

So you know, my area over here is violence. I had another kid that graduated with honors at Davis in political science and he was attacked by some violent guy, fractured his skull, broke his nose, knocked his teeth out, he's got permanent brain injury for the rest of his life. So I have a real, sincere interest in doing something on the violent side.

Donaldson is over here working with and has worked in 15, 20 years either on the neurodegenerative effects of manganese. My hot flash is that the quicker the National Institute of Justice who now has a submittal because of a law passed in California for 600 kids to go under a double blind study is to get the hell out of the criminal justice

business and go back and try to drill some oil wells. But right now there's nobody taking on the battle.

You've got to go out there -- dealing with a bureaucracy is really an experience, I'll tell you that. I have been laid, relayed and parlayed by the bureaucracy as a scientist but since I don't work for them, I'm not on the payroll, they can't fire me, I'm having the time of my life.

MR. POIRIER: I have a question for Dr. Donaldson. In the past 10 years manganese additives have been used in Canada. Are you aware of increases in ambient levels of the tri or tetroxide forms of manganese in air, water, soil, dust and if so, is there any epidemiological evidence that has shown any increases in Parkinsonism or any of the other neurodegenerative diseases that might be correlated to these increases if they are there?

DR. DONALDSON: That's an excellent question, once which actually would be addressed in the United States, actually. We live in a very sparse country, as you know. We're a tiny population, we're clustered along, actually, 200 miles north of the border and we have an area of almost 4 million square miles. So in terms of area, this sort of things would not be feasible within our own geographical --

MR. POIRIER: Not even in your cities? This work is not that --

DR. DONALDSON: Oh, there are monitoring --

manganese actually is monitored in the cities, particularly Ontario, actually. They have a number of scientists. The putative relationship between metals and neurological diseases is a problem that still remains to be addressed and one severe hinderance to this is acquiring personnel that have the interest and secondly, people that are really thoroughly qualified. Good neuroscientists to really address these problems and these types of individuals are not available within our government's service, unfortunately.

MR. POIRIER: The down shot is that data is not available to us at?

DR. DONALDSON: Yea, I'm afraid so.

MS. GILHOOLEY: I have a question for Dr. Donaldson about this paper number six that's in the package about manganese in the Canadian Environment, Associate Committee on Scientific Criteria for Environmental Quality of the National Research Council. Is this a report to that associate committee or did the associate committee adopt it?

DR. DONALDSON: This was adopted by the associate committee, of which I was a member and submitted to the Canadian government, actually, and I'd say we hopefully will see some action on it sometime.

I might actually add, within that document we've been discussing health effects, actually. The other members of

this committee, of which I was a member, were geologists and fish biologists and all types of individuals concerned with the environmental implications of manganese.

For example, it alters particularly the fish stocks in certain areas. It effects ... These things were addressed by my colleagues, actually, and are contained also within that document so it's not just health effects we're looking at, specifically.

MR. POIRIER: Dr. Donaldson, you earlier mentioned the earlier study done in which manganese dioxide was administered and you were able to extract a trioxide in you're potentially saying that the trioxide form is the neurotoxic form.

Are you aware of what effects, if any, the tetroxide form would have, is it similar to the trioxide or is it metabolized back to a trioxide, what is the chemistry with the tetroxide form of manganese?

DR. DONALDSON: Excellent question, actually. Excellent question. I arrived at this -- serendipity plays an enormous part and the same thing in this. This all occurred because of a faulty pH mirror, okay, 7.4, the standard procedure is used. This pH mirror was reading actually 8.2. The solutions were all 8.2.

I didn't understand it when I gave it to a graduate student to repeat his experiments, try the effects of

manganese on dopamine, and she didn't have any effect.

The experiments I had conducted, when I added manganese to dopamine solutions buffered at 7.4, my god, the dopamine was broken down in seconds and tremendous oxidation took place. Dose dependently when I add manganese. Even by as much -- as little as half a micromolar.

So I was incredulous when she could not repeat this. So I repeated it all and low and behold, it didn't work. So I was baffled at this and I sat down for about a week to try and figure it out.

I came to the conclusion that my colleagues pH mirror was on the blink. I went over there, he changed the situation and it had been reading, actually, about .7 to .8 units higher, actually -- or lower than I had been using.

So wasn't that strange? And then I looked into the physical chemistry and I find actually in alkaline solutions the predominant form of manganese is Mn3 and the pH I was using was 100 per cent so I had 100 per cent Mn3 Oh. Manganese hydroxide. Which caused a tremendous breakdown of the dopamine but normally it didn't really work very well or very, very slowly.

So this is when I got the idea of the trivalence form being the toxic form. I went back, as one does, to the old literature. What is buried there but we failed to see it. We don't look at it because we -- I'm talking myself -- we

have said we're looking for a definite theory and we find, my god, there it is there, way back in -- George Cotzias had mentioned this, the gifted pioneer of research on manganese neurotoxicity. He mentions it way back in the '50's.

His association with melanin and it's different -- it's ability to go to higher ... species and the possibility that maybe there would be a difference in the toxicity. This was left -- that took me into an area which I knew about but again, serendipity, a colleague had visited Dr. Petkas from the Atomic Energy Center who was an M.D. and a physicist and he taught be about free radicals.

I thought free radicals were refugees from Berkeley campus or something but free radicals are fascinating molecules which actually are produced and which we're now beginning to learn a little bit about and manganese, when it hits on dopamine, not only breaks the dopamine down but also releases large amounts of free radicals like the hydroxyl radical, an extreme super toxin. These are major toxins, actually propagated by manganese when it reacts with dopamine.

What is remarkable also is that manganese doesn't only produce these profound free radical toxins but it also has the ability to completely break down the normal neuronal defenses like GSA, glutathionine. They oxidize glutathionine as well, so it's a double whammy. It doesn't

only break down dopamine but it produces toxins which completely break down the whole neuronal defense system for free radicals so it's quite a remarkable thing, actually.

To answer your question, actually, I think it may have four forms and these should be looked at. I had mentioned in my papers three or four and it turns out people -- the physical chemists have done all this work and it's Mn3, actually, which does all the damage.

CHAIRMAN WILSON: I think that's all the questions. Thank you both very much for coming to see us. We're going to take about a five, ten minute break and then we'll have Ethyl Corporation.

(A brief recess was taken.)

CHAIRMAN WILSON: The last witness today is the Ethyl Corporation.

MR. WILKINS: Good morning. My name is Ray Wilkins. I'm a Senior Vice President of the Ethyl Corporation and President of Ethyl's Chemical Group.

I'm here to day to speak in support of our waiver application for Hi Tec 3000. With me today on the panel are Dr. Gary Ter Haar, Ethyl's Corporate Vice President for Health and Environment and F. William Brownell of Hunton & Williams, our counsel.

Also present to assist us in answering questions regarding our application are members of our technical staff

and the independent consultants who analyzed our test data.

Our goal today is to provide a brief overview of the test program and analyses ~~are~~ as described in detail in our waiver application documents and to answer questions concerning our waiver application. I recognize that it may be appropriate to respond more fully to some questions in writing after the hearing.

By way of summary, Hi Tec 3000 is an environmentally safe octane improver developed by Ethyl scientists. Our extensive tests show that the use of our product not only boosts octane but also reduces the level of regulated tailpipe emissions including a significant reduction in nitrogen oxides.

The additive saves crude oil and allows refiners to reduce aromatics and fuel vapor pressure. Furthermore, Hi Tec 3000 is completely compatible with gasoline containing oxygenates.

I will now continue with a description of the additive and an overview of our test program. As I've already indicated, the additive is a manganese based octane improver. The addition of about one-half teaspoon of the additive in a 20 gallon tank of gasoline improves the octane number of the gasoline by about one octane number.

This increase is achieved at approximately one-third the cost of the current available alternatives for enhancing

octane. Twice before Ethyl has sought EPA's approval to use the additive in unleaded gasoline.

Although EPA denied these requests due to insufficient supporting data, in both cases the EPA invited Ethyl to reapply for a waiver whenever adequate data on the effects of the additive on emission control systems were developed.

Since the completion of these two waiver application proceedings almost a decade ago, several hundred billion miles of vehicle service have been accumulated in Canada on gasoline containing the additive.

Moreover, we have completed a carefully designed test program in the United States. We believe that the time is now right for broad use of the additive in unleaded gasoline in the United States.

For this reason, Ethyl has filed a new waiver application to allow use of the additive in a concentration not to exceed 1/32nd of a gram of manganese as Hi Tec 3000 per gallon of unleaded gasoline.

To obtain a waiver for use of the additive, Ethyl must show that the additive will not cause or contribute to a failure of any emission control device or system to meet the emission standards for which vehicles are certified under the Clean Air Act.

To meet this requirement Ethyl has conducted the most extensive series of vehicle emission and other tests ever

undertaken by a private company. This test program was designed in consultation with both the automobile companies and EPA staff.

This test program involved 48 cars operated for a total of more than 3 million miles. Half of the cars used a test fuel containing the additive and half used the same test fuel without the additive. At each 5 thousand mile increment independent laboratories measured the tailpipe emissions from each vehicle to determine what effect, if any, the additive had on tailpipe emissions.

These data were then subjected to rigorous independent statistical analysis in order to evaluate the impact of the additive over 75 thousand miles of vehicle operation. These analyses show that the additive substantially reduces emissions of ~~hydrogen~~ nitrogen oxides while also reducing emissions of carbon monoxide.

The reductions in NOx emissions are illustrated in this chart. You will note that the reductions in Nox emissions associated with use of the additive begin almost immediately.

Chart two illustrates the overall reductions in carbon monoxide emissions. The reductions in carbon monoxide emissions begin to appear at about 25 thousand miles and become more pronounced thereafter.

These reductions for NOx and carbon monoxide and

continue and indeed increase in magnitude as milage accumulation increases.

The NOx and CO emissions reductions result from two beneficial effects of the additive. First, the additive reduces engine out NOx and carbon monoxide emissions. Second, manganese oxide acts as a catalyst, making the converter and other components of the emission control system more efficient in removing nitrogen oxide.

This NOx effect is addressed in a paper prepared by Dr. Roy Harrison of the University of Lancaster, England and Dr. Harry Edwards with Colorado State University which is part of Appendix 9 to the waiver application. We plan to submit additional information on this issue for the record in our written comments after the hearing.

You should also note that these reductions in NOx and carbon monoxide emissions occur without a material change in hydrocarbon emissions.

Chart three illustrates the overall effect of the additive on hydrocarbon emissions. The independent statistical analyses performed by Systems Applications, Incorporated and Roberson Pitts, Incorporated show a close correspondence between hydrocarbon emissions for cars using the additive and cars using clear fuel.

Indeed, according to these analyses, the only statistically discernable change in emissions associated

with use of the additive occurs within the first 5 thousand miles of vehicle operation. This is a very small change, an increase of only .017 grams per mile. At 50 thousand miles no additional statistically discernable change in hydrocarbon emissions is observed.

Chart four illustrates the average differences in emissions between the clear and additive fuel vehicles for each of the three pollutants. As the statistical analyses of these data show, the very small increase in hydrocarbon emissions will not cause or contribute to the failure of emission control systems to meet emission standards. Either existing standards or those that may result from proposed legislation.

Even the very small emissions increase observed in the test program should not occur in commercial operations as refineries use the additive in place of aromatics in unleaded gasoline.

By comparison, EPA has granted other recent fuel additive waivers even though emissions of one pollutant clearly increased, as long as overall emissions decreased.

The very small increase in hydrocarbon emissions observed in the test program therefore is not a reason for concern with respect to our application.

As pages 46 to 56 of the waiver application and Appendix 10, we provide a full explanation of why the slight

hydrocarbon emission increase is unimportant as a practical matter. I urge you to closely review these materials.

In addition, Shep Burton of SAI and Ralph Roberson of RPI, the independent consultants responsible for the statistical analyses of the data, are available to answer your questions regarding their analyses.

In sum, Ethyl has met the statutory standard. Moreover, based on the results of Ethyl's test program, total emissions in cars using the additive, including reduction in noxious pollution such as benzine and formaldehyde could be reduced by up to 1.7 billion pounds per year by 1999. These reductions are summarized in Chart 5.

In addition to tailpipe emission testing, Ethyl also conducted extensive testing to determine what impact, if any, use of the additive has on the materials used in automotive emission control systems.

This testing shows that the additive will not cause plugging of catalytic converters. In fact, Ethyl testing shows that catalytic converter efficiencies were actually improved by the presence of the additive in the fuel.

These results are summarized in this chart. The chart shows the average loss in converter efficiency for the clear and additive fuel test vehicles. Ethyl's testing also shows that use of the additive will not adversely effect the

operation of oxygen sensors or materials used in the automotive fuel system.

Indeed, Petro-Canada, Incorporated, referring to the preliminary results of a study it commissioned to investigate whether the additive causes plugging recently observed that automobiles in Canada using fuel containing Hi Tec 3000, up to twice the concentration requested in this waiver application, have shown no signs of catalyst plugging after almost 100 thousand miles of vehicle operation.

Of particular note, the preliminary results of this study shows that the catalyst with the highest manganese level had the best performance in terms of emissions.

A copy of a letter to the editor of Octane Week from which this information was derived is available for your review.

Our test program further confirms that there is no cause for concern with catalyst plugging or engine deposits. Appendix 3 and pages 33 to 37 of the waiver application present a more detailed explanation as to why these concerns are unfounded.

In light of the on-going efforts to reformulate gasoline to reduce automobile emissions, Ethyl has also conducted a series of tests to confirm the compatibility of Hi Tec 3000 with reformulated fuels.

In one of these tests we examined whether use of the

additive with a wide variety of fuel blends containing ethanol, MTBE and methanol would adversely effect automotive materials. We found that it would not.

In a second set of tests we examined the octane effectiveness of Hi Tec 3000 in this same variety of fuel blends. We found that the additive compliments the octane improving characteristics of other additives such as MTBE. These results are summarized in Chart 7.

This means that Hi Tec 3000 can be used to reduce the aromatic content of reformulated gasoline without sacrificing octane and thereby further reducing emissions of both criteria pollutants and other pollutants such as benzine and formaldehyde.

In a third series of tests we examined more directly the emissions effect of using the additive in a reformulated fuel containing five per cent MTBE. This testing confirms that the additive will reduce significantly NOx emissions, will reduce the aromatic content of hydrocarbon emissions and will reduce carbon monoxide emissions.

The hydrocarbon emission results are of particular interest. While total hydrocarbon emissions remained about the same, the reactivity of those hydrocarbon emissions decreased with use of the additive.

Testing of other fuel blends show similar results. We will submit further information on this issue in our post

hearing comments.

Use of the additive by refiners will also reduce butane production, the supply of which will be in surplus under new Reed Vapor Pressure regulations. With reduced butane, lower vapor pressure specifications for gasoline are more easily attained and evaporative or running losses from vehicles in hot weather can be reduced.

In sum, the additive is compatible with a wide variety of fuel blends and the emission reductions made possible by the use of the additive will compliment the emissions reductions made possible by the use of reformulated gasolines such as oxygenated fuels.

Use of the additive will allow refineries to operate under less severe conditions. As a direct consequence, cruel oil imports could be reduced by about 30 million barrels per year. At $18 per barrel, this savings would amount to a reduction in imports of nearly $540 million per year and would be more than the amount of oil stored annually in the Strategic Petroleum Reserve.

Finally, I would like to emphasize that use of the additive will have a positive environmental effect. As I discussed earlier, the use of the additive will result in substantial reductions in automobile exhaust emissions of both criteria pollutants and aromatics.

Use of the additive will also reduce the emissions of

pollutants from refineries because use of the additive allows refineries to operate under less severe conditions.

These reduced levels of automotive and refinery emissions would of course translate into lower ambient concentrations of pollution and reduce population exposure to pollution.

In this regard, Ethyl asked SAI to examine the potential impact of the use of the additive on ambient ozone concentrations. This analysis shows that modest but nonetheless meaningful reductions in ambient ozone concentrations could occur in some cities.

In Philadelphia, for example, the reduction in ambient ozone concentrations would be the same as that achieved by removing approximately 170 thousand cars from the streets of the city.

These potential improvements would be the result, at least in part, of the lower reactivity of automotive emissions attributable to the use of the additive.

It should also be emphasized that the manganese emissions associated with the use of this additive would be extremely small, on the order of five-one thousands of a milligram per mile.

As a result, the maximum increased ambient concentrations of manganese resulting from the use of the additive in a typical urban area such as Philadelphia would

be only .001 micrograms per cubic meter, a level nearly too small to measure.

EPA's own health review of manganese, the Health Assessment Document for Manganese in 1984 concludes that low level manganese emissions present no health concerns. Indeed, an even more recent report completed by Health Effects Institute entitled Potential Health Effects of Manganese in Emissions from Traffic with Diesel Vehicles concludes that emissions caused by use of manganese fuel additives in diesel fuel vehicles present no public health risk, even at ambient manganese levels far in excess of those which would result from the use of Hi Tec 3000.

The overall effect of the additive on public health and welfare therefore is positive. It will lead to substantial reductions in the emissions of regulated pollutants and in reduced ambient concentrations of these pollutants and will not cause any perceptible change in background concentrations of ambient manganese.

I would now like Dr. Ter Haar, Ethyl's Corporate Vice President for Health and Environment, to expand briefly on my remarks concerning public health.

DR. TER HAAR: Thank you, Ray. Good morning. Use of Hi Tec 3000 performance additive will result in infinitesimal addition emissions of manganese. As you can see from Chart 1, greater than 99.9 per cent of the Hi Tec

3000 is burned in the combustion process.

The principle combustion product is MN 304. Based on testing of vehicles in the Ethyl test fleet, a current model automobile fueled on gasoline with the additive would release about .06 grams of manganese to the ambient air on an annual basis or only about 0.5 grams of manganese over the course of 100 thousand miles of vehicle operation.

Chart 2 depicts the mean results of particular emission testing on several of the test vehicles used in the Ethyl test program. You can see from this chart that on the average only about .4 per cent of the manganese added to the fuel is emitted to ambient air and that is inorganic manganese.

As a result of these exceedingly small emissions, the additive will have virtually no impact on ambient concentrations of manganese. For example, in a typical urban area like Philadelphia, one could expect conservatively maximum increased ambient concentrations of manganese of about only 0.001 micrograms per cubic meter.

By way of comparison, EPA has estimated that large point sources can cause maximum ambient manganese concentration of over 100 micrograms per cubic meter.

Data from the United States National Air Surveillance Network and from Canada where the additive has been used in virtually unleaded gasoline for over a decade confirm what

these estimates suggest, that the ambient concentrations of manganese are a function of normal background concentration in large point sources and that the use of the additive will have no discernable effect on ambient manganese concentrations.

Chart 3 shows a comparison of airborne manganese levels in the United States, Canada and the United Kingdom. You will note that the levels of ambient manganese are very low and essentially the same in all of these countries.

The level of ambient manganese -- the levels of ambient manganese are comparable even though Hi Tec 3000 has been and is used extensively in Canada and has never been used in the United Kingdom.

The low ambient concentrations of manganese stand in sharp contrast to typical soil concentration. Soil concentrations of manganese are typically over one thousand parts per million which can be explained by the fact that manganese is the 12th most abundant element in the earth's crust.

For this reason, manganese is typically found in food products. In fact, food serves as the largest source of manganese for man. Chart 4 shows the manganese levels in several food groups.

You can see from this chart that grains and cereals contain large concentrations of manganese and that one cup

of tea may contain as much as 12 hundred micrograms of manganese. Dietary intake of manganese ranges from two thousand to nine thousand micrograms per day, averaging about three thousand micrograms.

This daily intake accounts for an excess of 99 per cent of the amount of manganese absorbed by the body. Chart 5 shows that approximately three to four per cent of the average daily intake is absorbed from the intestinal tract. This results in a typical daily uptake of 120 micrograms from dietary sources.

The contribution from inhalation is minuscule in comparison, only 0.4 micrograms are absorbed daily by inhalation. Since the use of Hi Tec 3000 will result in only 0.5 grams of manganese being emitted over a -- from a single automobile over the course of 100 thousand miles, typical ambient manganese concentrations will not change measurably.

As a result, the amount of manganese absorbed from the diet is and will continue to be greater than 100 times the amount absorbed from air. Even if Hi Tec 3000 is used in all gasoline.

It is also important to contrast the small inhalation uptake with existing occupational exposure limits. These limits are shown in Chart 6. These occupational exposure limits have been established to safeguard workers exposed

eight hours a day, five days a week for a lifetime from adverse health effects. They are many orders of magnitude higher than existing ambient manganese concentrations.

It should also be emphasized as Chart 7 shows, manganese is a biologically essential trace element. It has been recognized for many years as being present in trace quantities in the cells of all living organisms. A deficiency in manganese has been associated with skeletal abnormalities and ... of the newborn and defects in lipid and carbohydrate metabolism.

Moreover, metabolism is controlled efficiently by the hemostatic mechanisms so the tissue concentrations are maintained at stable levels despite large variations of manganese intake.

Indeed, manganese is present, as has been noted earlier this morning, in most if not all vitamin supplements at levels of one thousand to ten thousand micrograms.

There are those, however, who would suggest that no amount of manganese, however small, should be added to the environment. This is a simplistic view that ignores dose response relationships.

All countries, including the United States, who have evaluated the health effects of low levels of manganese in the air have concluded there is no health risk from these levels.

These scientists realize that appropriate risk assessments acknowledge the difference between toxic effects at very high levels of exposure and beneficial effects at lower levels from materials such as manganese.

They further understand that an increased uptake of less than one per cent from daily inhalation, when compared to what is normally absorbed in the diet, poses no health risk.

For example, studies by Canada's Ministry of Health and Welfare, the Canadian Journal of Standards Board, Environment Canada and Transport Canada have determined that the additive has no environmental or health effect. They have concluded, "Review of available information on industrial and community exposure to manganese and results of studies in animals of chronic inhalation of manganese exhaust products lead to the conclusion there is no evidence at present to indicate that expected ambient manganese concentrations would constitute a hazard of human health."

A special Royal Society of Canada commission came to a similar conclusion. "MMT has already been used for eight years in unleaded gasoline. The additional exposure to manganese is well within the normal range presented by dietary variations and is likely to remain so. Couper's view that the general public has a wide margin of health safety with respect to the worst case of MMT in gasoline

appears to be sound."

Finally, in the United States the Environmental Protection Agency has issued a health assessment documents concluding that, "Manganese emissions at levels found today present no public health concerns, even around large point source emitters such as steel mills and power plants. EPA concluded that it is determined that present ambient air concentration of manganese do not pose a significant risk to public health and that no regulation directed specifically at manganese is necessary at this time under the Clean Air Act."

In summary, the vast amount of practical experience from Canadian use of Hi Tec 3000 and the significant body of knowledge produced in numerous studies all come to the conclusion that Hi Tec 3000 has no adverse effect on the environment or on human health. Thank you.

MR. WILKINS: Thank you, Gary. Ethyl has thoroughly and fairly documented in its waiver application that this additive meets the statutory standard for approval of a waiver application.

This final chart summarizes the results of our test program. We have shown that Hi Tec 3000 will significantly reduce the amount of crude oil that's used, it will allow refiners to operate at less severe conditions and reduce point source emissions at refineries, it is compatible with

all types of gasoline, it has no harmful effect on catalysts. As a matter of fact, it enhances catalyst performance.

It will cause no health or environmental problem and probably most important, it will significantly reduce emissions from automobiles. We therefore encourage your prompt approval of this application. Thank you for your attention and we'll be happy to try to answer any questions you might have.

CHAIRMAN WILSON: Thank you very much. I note your careful preparation includes bringing your own water. That's one of the advantages of being last, I guess.

Mr. Poirier is going to have to leave to catch a plane so I think I'll let him ask his questions first.

MR. POIRIER: What percentage of the manganese oxide emission is ... oxide form?

DR. TER HAAR: The product coming out of the tailpipe, as far as we can determine from xray diffraction is predominantly Mn 304. The exact percentage, obviously, in a complex ... coming out of the tailpipe is hard to determine precisely but that's our best estimate.

MR. POIRIER: In your particle analysis, is most of the particle, I assume, is in the .2 and the .4 --

DR. TER HAAR: That is correct. Of the material that comes out.

MR. POIRIER: In that range there's no further differentiation of particle size? Is that just one range that was set aside as a measurement as opposed to .4 and larger or .2 and lower?

DR. TER HAAR: Generally speaking, exhaust product -- primary products are typically less than a micron in size and it's difficult to distinguish them as they get smaller and smaller. The techniques are difficult.

MR. POIRIER: Okay. So there's no data to look at the distribution of the tetroxide form with a particular particle size?

DR. TER HAAR: That has not been done, to my knowledge.

MR. POIRIER: Have you been following up on the manganese oxide emissions in Canada and looking at increases in ambient levels both air and water?

DR. TER HAAR: We have not looked at water and of course, if we would do a calculation on the amount that goes in the air here, the amount from the use of this product is so infinitesimal that I wouldn't expect to see any possibility of finding it in the water if I looked for it.

The evidence from the data that we showed you is no discernable effect on the concentrations in the cities in Canada.

MR. POIRIER: Have you attempted to monitor any

potential health effects from the manganese tetroxide in the population in Canada?

DR. TER HAAR: No. We have depended on the scientific bodies who, from the data I showed you, obviously Canada continues to look. They looked in '78, they looked again in '84. The United States has been looking at this, Australia has been looking at this.

All of these groups. We have submitted our information to them. They get information from everyone else who is interested in that and we have depended on those expert groups. Obviously, we follow the literature closely but we depend on those groups to make those judgments.

MR. POIRIER: Okay. So you have no intentions or have not initiated any efforts from Ethyl's point of view to look at potential health effects of the tetroxides?

DR. TER HAAR: We have done extensive studies on that back in the '70's. Animal studies, high levels. There are several studies. I'm sure we cite them in our waiver and we can give you more information on those animal studies.

We have supported a tremendous amount of work on research and animal studies on manganese oxides. The material was burned in a flame, just as it would be in a combustion process and that material introduced directly into the areas where both primates and rodents were exposed.

In addition, the work sponsored by agencies -- not just Ethyl but government agencies has been done by a University of New York. It escapes my mind at the moment. Mike Carlson and his group did the work on that and showed no effects from those studies.

MR. POIRIER: In those studies that you're referring to, before introducing the combustion product to the animals, was speciation of the oxide forms undertaken?

DR. TER HAAR: I do not remember if we -- the size was looked at. The size was clearly looked at.

MR. POIRIER: The type of oxide was not, is that correct?

DR. TER HAAR: I do not recall. That data would be in the report.

MR. POIRIER: Thank you. I don't have any further questions.

CHAIRMAN WILSON: Do you have comments to make to other groups or witnesses who had critical comments to make vis-a-vis the health effects of manganese?

MR. WILKINS: I think my comment on recognizing dose effect, the question that was asked earlier on is it safe for me to take my vitamins, I think the answer to that is clearly yes. All evidence is that the body very effectively controls the biological use of manganese and that the mainline medical authorities recognize it is

essential and of critical importance to just a wide variety of necessary functions in our body.

It's in there because the medical profession and the government has -- it's in vitamins because the medical profession and the government has found it to be appropriate and I think the sense of dose and the concept of the very minuscule amounts that are present here were missed by the other responders.

CHAIRMAN WILSON: Let we switch subjects, I guess, a little bit. Can you explain why it is that the additive results in decreases of carbon monoxide and nitrogen oxide but does not decrease and in fact seems to increase hydrocarbon?

MR. WILKINS: All right. I can take a shot at that. We're going to present more data to the -- with our written comments addressing these issues.

When we talk about engine outs, we measure those just in front of the catalyst and so by that time there has -- the gas has already began to move down the exhaust system.

Calculations by Dr. Harrison from England indicate that the manganese oxide on the surfaces of the exhaust system, before it reaches the catalyst theoretically are capable of reducing the nitrogen oxides to nitrogen and oxide. Not nitrogen and oxygen. And that the engine out, as we see it, the reduced engine outs are consistent with that

observation.

Then, furthermore, that same effect continues on the catalyst surface and so we see an additional increase in efficiency on the catalyst surface. So I think it's fairly clear that -- and he has done studies in the laboratory in a work we'll submit to you showing the same effect without having an automobile involved.

So I think the nitrogen oxide reduction is pretty clearly a catalytic effect. The same would appear to be true of the manganese oxide, acting as an oxidation catalyst on the -- on CO.

Again, before the catalyst. There's no effect on the catalyst one way or another on efficiency as far as CO is concerned. The positive effect from CO appears to be mostly in engine out or the effect that's going to take place takes place in the early part of the system, probably when the gases are hottest.

This is consistent with the data that we see that it's delayed in time. We need to have enough material on the surface of the exhaust system so that the oxidative process can take place.

The hydrocarbon emissions are probably due to a slight increase in engine outs actually coming out of the cylinder and are not effected by the manganese oxide, does not have a catalytic effect either in the catalyst or in the exhaust

system.

CHAIRMAN WILSON: So you don't see a positive catalytic effect within the catalyst for either CO or hydrocarbon, only for manganese?

MR. WILKINS: It just about -- there's a slight -- as you'll see in the data, there's a slight, slight positive for CO but very slight and for hydrocarbons, the catalyst has no effect on efficiency, either positive or negative for hydrocarbons.

CHAIRMAN WILSON: What work have you done on the -- to analyze the effect of -- over the -- you ran many tests up to 75 thousand miles, what have you done to look at the effect of the additive on the durability of the catalyst? Have you done catalyst analyses?

MR. WILKINS: We have done very little on the catalyst analyses themselves. The key part of the study that we think is the most important is that we do not see any adverse emission effects, rather positive effects.

In the real world, driving these 48 cars and comparing these, we see the positive effects on the emissions at the tailpipe.

We will -- we have looked at the surface of a few of the catalysts. Most of them are still on the cars. And we see no evidence of any plugging and the back pressure measurements that we made, which are part of our waiver,

demonstrate there is no back pressure problems with the catalysts.

CHAIRMAN WILSON: To your knowledge, has the auto industry found problems with the use in Canada?

MR. WILKINS: I'm sorry?

CHAIRMAN WILSON: I'm asking whether to your knowledge the auto industry found problems with the use of MMT in Canada.

MR. WILKINS: As far as we can tell, there is no evidence that there are any more problems with the United States -- in Canada then there are in the United States.

That is, there are occasional catalysts that plug, there are occasional catalysts that get too hot and are destroyed, both in the United States and in Canada. To our knowledge, there's no evidence that the situation is worse in Canada than it is in the United States.

CHAIRMAN WILSON: Have you discussed your data with auto industry and they're satisfied with your --

MR. WILKINS: In great detail. You have to understand that this is the first time they're really seen the significant effects of this product. The very positive effects of this.

This sophisticated study really gave us the opportunity to conclusively demonstrate the positive effects on the tailpipe. These are new facts for them. They are material